

IOWA STATE UNIVERSITY

Digital Repository

CARD Working Papers

CARD Reports and Working Papers

11-1998

Are Eco-Labels Valuable? Evidence from the Apparel Industry

Wesley Nimon

North Carolina State University

John C. Beghin

Iowa State University, begin@iastate.edu

Follow this and additional works at: http://lib.dr.iastate.edu/card_workingpapers



Part of the [Agricultural and Resource Economics Commons](#), [Agricultural Economics Commons](#), [Economics Commons](#), and the [Fashion Business Commons](#)

Recommended Citation

Nimon, Wesley and Beghin, John C., "Are Eco-Labels Valuable? Evidence from the Apparel Industry" (1998). *CARD Working Papers*. 243.

http://lib.dr.iastate.edu/card_workingpapers/243

This Article is brought to you for free and open access by the CARD Reports and Working Papers at Iowa State University Digital Repository. It has been accepted for inclusion in CARD Working Papers by an authorized administrator of Iowa State University Digital Repository. For more information, please contact digirep@iastate.edu.

Are Eco-Labels Valuable? Evidence from the Apparel Industry

Abstract

Environmentally friendly labels, or eco-labels, have begun appearing on products in the United States and Europe as a manifestation of industry efforts to be perceived as environment-friendly. This study investigates the extent of market valuation of the environmental claims made by apparel manufacturers.

Disciplines

Agricultural and Resource Economics | Agricultural Economics | Economics | Fashion Business

Are Eco-Labels Valuable? Evidence from the Apparel Industry

Wesley Nimon

North Carolina State University

John Beghin*

Iowa State University



CARD Working Paper 99-WP 213

Center for Agricultural and Rural Development

Iowa State University

1. Revised November 1998

Without implicating them, the authors thank participants at the 1998 AAEA meetings, the 1997 Camp Resources Conference, the 1997 Southern Economics Association Meetings, and workshop participants at Iowa State University, NC State University, and USDA, and Mary Bohman, Alastair Hall, Tom Johnson, Jeff Kraus, Barry Krissoff, Ray Palmquist, Brian Roe, Jim Rucker, Kevin Smith, Kevin Sweeney, Mario Teisl, Walter Thurman and three anonymous referees for discussion and comments. We are indebted to Kevin Smith for his suggestion to use catalogue data. The authors acknowledge financial support from USDA-NRI project No 9603068.

ABSTRACT

Using U.S. apparel catalogue data, we estimate hedonic price functions to identify market valuation of environmental attributes of apparel goods. We identify a significant and robust premium for the organic fibers embodied in the apparel goods. We also find a discount for the "no-dye" label. We do not, however, find any evidence of a premium for environment-friendly dyes. We further investigate the pricing behavior of apparel suppliers for potential heterogeneous pricing of the organic-fiber attribute and find no evidence of different premia across firms.

Keywords: Eco-labels, organic-cotton apparel, dyes, hedonic price

JEL Classification: Q20, L81, L67

ARE ECO-LABELS VALUABLE? EVIDENCE FROM THE APPAREL INDUSTRY

Introduction

Environmentally friendly labels, or eco-labels, have been appearing on a number of products in the United States and Europe (Wasik 1996, OECD 1997). These labels are the manifestation of industry efforts to become or to be perceived as environment-friendly. They also reflect environmental regulatory changes, especially in regulation-minded European countries. In some instances, such as the dolphin-safe tuna case, these labeling initiatives have preceded regulation mandating the touted environmentally friendly attribute (Teisl et al. 1997). A similar recent occurrence concerns eco-labels in the textile/apparel industry. For example, in the United States, agencies, such as the California Certified Organic Farmers and the Texas Organic Cotton Cooperative, certify organic cotton farmers and allow firms selling apparel made from their cotton to market them as certified organic cotton apparel.

Despite some qualitative analysis, there has been minimal quantitative economic work on these labels (Teisl et al. is a notable exception). We investigate the extent of market valuation, if any, of the environmental claims made by apparel manufacturers. Particularly, we estimate the price premium for the “organic-cotton apparel,” “environmentally friendly dyes,” and “no-dyes” appellations, as well as the existence of a health component in addition to the non-use valuation of environmental characteristics of apparel goods.

Second, our disaggregated data set provides an opportunity to investigate pricing behavior by retail apparel suppliers. The green apparel market predominantly consists of a presumably competitive fringe of small mail-order firms, and of one large firm, Patagonia, which is really the only candidate that might wield market power in the organic cotton apparel industry. Patagonia’s nearly \$15 million (in 1995) sportswear division exclusively uses organic cotton (Imhoff 1995)). This firm’s potential market power could raise the marginal price premium above its marginal cost. Price setting of attributes by this single firm would complicate the interpretation of the results. The eventual premium would have two components; the marginal cost of supplying the environmental attribute, and the price markup resulting from the market power.

Our analysis is based on the hedonic price function (Freeman 1993, and Palmquist 1991). Recent notable contributions include Osborne (1995), Michaels and Smith (1990), Palmquist et al. (1997), and

others. The major contribution of our paper, in reference to the existing literature, is to address the valuation associated with ecological claims embodied in the labels. In addition, we attempt to investigate the pricing behavior of organic apparel suppliers within the hedonic approach. The treatment of the latter issue has been difficult and limited (see Osborne and Smith 1997, and Feenstra and Levinsohn 1995).

We find a significant and robust price premium for organic cotton, but little evidence of a premium for environmentally friendly or low impact dyes. The average “organic” markup is about 33.8 percent of the apparel price for a large selection of apparel items. Further, apparel items sold without dyes at all sell at a substantial discount of about 15 percent. This discount is consistent with actual cost savings implied by the absence of the dying process. Further, our results suggest that the organic-fiber attribute appears to be priced similarly across the organic apparel retailers included in our data set.

Background on Eco-Labeling and the Organic Cotton Market

Eco-labels present some difficulties in the international context, because requirements to establish the label may serve as *de facto* trade barriers (Zarrilli et al. 1997). Despite this shortcoming, voluntary labels bring an unusual consensus from many fronts, appealing to economists, ecological groups, and industry groups. In markets where consumers show preferences for “green” products, firms support eco-labels because they offer a way to differentiate their products from others in the same class. Ecological groups generally support eco-labeling initiatives as a way to encourage firms to reduce their products’ adverse environmental impacts (Wasik 1996).

Economists like the labels because they are voluntary and let the market reveal the potential valuation of environmental attributes, and because they move the market closer to full information by transforming a credence attribute into a search one, assuming that the labels contain accurate information (Nelson 1970). Labels provide a market-oriented instrument to achieve environmental goals, and thereby avoid the inefficiencies associated with mandatory standards, or bans.

From a conservationist perspective, eco-labels are educational tools to inform consumers about the environmental impacts of the labeled product, and thereby induce a change in purchasing behavior that mitigates the product’s environmental damage. This aspect appeals to granola-types and environmental interest groups because firms fund the educational program as part of their promotional efforts.

The U.S. organic cotton market emerged a few years ago, and it has been growing rapidly from 1991 with 800 acres of organic cotton to 1994 with 36,000 acres (Imhoff 1995). Organic cotton is grown without the use of any synthetic insecticides, fungicides, herbicides, or fertilizers. Conventional cotton

farming methods are much more chemically dependent than most crops and it is this fact that has spurred an interest in organic cotton textiles (Bowen 1991, and Imhoff et. al. 1996). There is evidence of groundwater contamination caused by agricultural chemicals, and since cotton farming is exceptionally dependent on these chemicals it seems a reasonable crop on which to concentrate these concerns. In a recent document, the U.S. Environmental Protection Agency (EPA) made the argument that over the last 20 years there has been significant investment in point source pollution reduction technologies, but relatively little in nonpoint source pollution control (USEPA 1992). A 1992 study by the Bureau of Business Research at the University of Texas at Austin reports that consumers who prefer clothing made from organic cotton do so primarily for environmental concerns (Apodaca 1992). The price premium for the environmental attributes largely reflects the consumer's valuation of the decreased environmental impact of organic cotton apparel.

Health concerns, especially for young children, represent another potential source of benefits and demand for organic apparel. There is little evidence that conventional cotton apparel contains levels of pesticide residues that cause any adverse health effects. Clothing catalogues included in our database, such as "The Natural Baby Catalogue," nonetheless claim that organic cotton clothes are "healthy for babies because there are no pesticide or chemical residues to be absorbed through the skin." These Catalogues go as far as implying potential toxicity of conventional cotton and raising fears of contamination by dioxins resulting from the bleaching and dying processes. The Texas Organic Cotton Marketing Cooperative, in pamphlets it distributes has insinuated similar fears. Industry groups, such as the National Cotton Council have challenged this alarmist view. Since defoliates are the only chemicals applied after the cotton boll opens, the chemical residue on the fiber is negligible. In fact, major organic-cotton growers, such as Sally Fox of Natural Cotton Colors, Inc., a main producer of naturally colored and organic cotton in the United States, concurs that health benefits from organic cotton apparel may be minimal despite contradictory claims (Burnett, et al. 1995).

Since these health claims have not been thoroughly debunked, consumers may believe in the existence of valuable health benefits, especially for youngsters, from wearing organic-cotton apparel. If there are perceived health benefits, then one would expect the price premium for organic apparel to contain an additional health component, beyond the environmental benefit associated with organic items for babies and with the dyes. We try to shed some light on that question by investigating the existence of premia associated with organic apparel items for young children. This roundabout way to investigate the health claims is dictated by the lack of direct categorical data available on environmental benefits claims versus health benefits claims in the labels. Our conjecture is that if there were a health component in the organic premium, it would manifest itself most strongly in items for children, who are perceived to be more susceptible to toxins.

The Hedonic Framework

In this section we first introduce the hedonic framework leading to the estimated equations, and then explain how we intend to test pricing behavior. We refer readers to Freeman (1993) or Rosen (1974) for a more detailed presentation of the hedonic framework. We are interested in identifying price premia/discounts associated with the environmental characteristics of the apparel advertised by the eco-label. A first stage hedonic price function is an appropriate approach to our problem. It allows us to estimate the implicit prices of the attributes of a good, including its environmental characteristics. Rosen (1974) developed the seminal model of a competitive market for a differentiated good in which consumers' and producers' interactions generate an equilibrium. Hedonic prices are the implicit prices of attributes of a differentiated product.

The producer is assumed to maximize profits. The offer function, $\phi(z; \pi, B)$, is the minimum price the firm is willing to offer a bundle of attributes z , given some level of profits, π , and some cost structure parameterized by B . This z accounts for the possibility that some firms are better suited to produce a particular bundle of attributes than others are. All firms maximize profit, $\pi = MP(z) - C(M, z; B)$, with respect to the arguments of the cost function, M and z , where M is the quantity produced of the good and z is the vector of attributes of the good. The assumption here is that each firm only produces a single bundle of the good. It produces the bundle for which it is best suited, given its underlying cost function summarized by the parameter B . In this way the model only treats joint production in the limited sense that a firm may own two plants producing different bundles, but there are no cost dependencies necessary for meaningful joint production.

Differentiation of profits with respect to z gives $\partial\pi/\partial z = M(\partial P/\partial z) - \partial C/\partial z = 0$ or,

$$(1) \quad P_{z_i} = \frac{C_{z_i}}{M}.$$

Hence, the offer price of the i^{th} attribute must equal the per unit marginal cost of that characteristic. In a competitive market, firms cannot influence prices. Thus, the firm maximizes profit when it charges the market price (i.e. the highest price it can) for each of the attributes of the good it produces. The maximum profit then occurs when $P(z) = C_M(M, z, B)$. The firm's offer function, $\phi = \phi(z; \pi, B)$, is the price at which the firm would be willing to make available a particular product. It is defined implicitly as $\pi = M\phi - C(M, z; B)$, and must equal the marginal cost of production, $\phi = C_M(M, z, B)$. A set of production "indifference" curves can be found from the necessary condition for profit maximization with respect to the output quantity M , yielding

$$(2) \quad \phi = C_M(M, z, B).$$

The consumer problem mirrors the producer problem. Consumers maximize utility subject to a budget constraint $[\max U(x, z_1, \dots, z_n) \text{ s.t. } y = x + P(z_1, \dots, z_n)]$, where x is a numeraire whose price is unity, the z 's are attributes of the differentiated good being purchased, and y is his income. By assumption each consumer purchases only one unit of the good, which contains the utility maximizing bundle of characteristics. The consumer's bid function $\theta(z_1, \dots, z_n; u, y)$ mirrors the offer function and it is the amount the consumer is willing to pay for a particular bundle of characteristics, given his income and some fixed level of utility. Noting that $x = y - \theta$ this bid function is defined such that

$$(3) \quad U(y - \theta, z_1, \dots, z_n) = u$$

Differentiating (3) with respect to z_i yields $(\partial U / \partial x)(\partial x / \partial \theta)\theta_{z_i} + \partial U / \partial z_i$ and since $\partial x / \partial \theta = -1$,

$$(4) \quad \theta_{z_i} = \frac{U_{z_i}}{U_x}$$

Thus, θ_{z_i} is the marginal rate of substitution between the attribute z_i and "money," i.e., x . In other words θ_{z_i} is the marginal implicit valuation the consumer places on the attribute z_i at a given level of utility and income. When considering all attributes of the good, $\theta(z_1, \dots, z_n; u, y)$ is the maximum the consumer is willing to pay for the product while $P(z)$ is the minimum he must pay. In this case utility is maximized when $\theta(z^*; u^*, y) = P(z^*)$ and when $\theta_{z_i} = P_i$. Utility is maximized when the consumer chooses a bundle such that the price he is willing to pay for each attribute exactly equals what he has to pay. Since consumers are paying $P_i(z)$ for each attribute and firms are charging $P_i(z)$, then the equilibrium condition is $P(z) = \phi_{z_i}(z^*; \pi^*, B) = \theta_{z_i}(z^*; u, y)$.

If there are many firms and many consumers, then the tangency points of consumers' and producers' indifference surfaces trace out the hedonic price function representing the price of the good holding all the attributes constant except one. Further, Rosen establishes that in the long-run the supply side of the market completely characterizes the hedonic price function, which represents the minimum price at which characteristics can be bought and produced. This longrun equilibrium implies that the marginal price of a particular attribute, evaluated at a fixed level of the attribute, should be equal across firms, holding other things constant, and should correspond to the lowest marginal cost of producing that characteristic's particular level.

This equilibrium characterization with entry allows us to derive implications on marginal cost pricing based solely on information on pricing behavior of organic apparel suppliers. The test checks for equality of the marginal prices of environmental attributes across firms, holding other things equal. This

simple test is consistent with the more elaborate test of price-setting behavior proposed by Osborne and Smith based on cost of production. Using Feenstra's (1995) framework, the latter authors look for evidence of price markup above marginal cost of characteristics. The lack of data on cost precludes us from adopting this preferable and sophisticated methodology. Our approach presents the drawback of not spelling out the economic behavior or structure leading to a well-specified alternative hypothesis. However, our test presents the virtue of simplicity and abstracts from the strong structure of the Feenstra, and Osborne and Smith approach necessary to derive well-defined markup behavior.

The Data

Our data are unconventional, but reliable. We collected price and characteristic data for apparel, which we extracted, from retail order catalogues (mail catalogues and others). The data was collected between May and October of 1996. This was done first for organic items. The search for the organic apparel firms combined internet searches and was extensive if not exhaustive. We believe we collected nearly the whole population of the retail organic cotton apparel industry that provide catalogues. (There are organic apparel retail shops that do not advertise by catalogue, and we do not cover those outlets.) Besides the internet, sources included various apparel wholesalers and retailers, and organic cotton producer associations. The incentive structure faced by firms reinforces our belief in the extent of our search. Firms want to be noticed and catalogues are powerful signals. We only found four catalogues jointly offering both conventional and organic cotton apparel, which is not so surprising, given the organic-conventional antagonism used in organic marketing.

The data search for conventional cotton apparel proceeded in a similar fashion, but since the conventional market is so vast, an attempt was made to sample retailers across the whole spectrum of quality and styles. For each firm and for both apparel types, we have a large cross-section of items (pants, T-shirts, long-sleeve shirts, etc.). In total we have 27 apparel firms in our data set, 15 of which are specialized in organic apparel. The data set, including the list of firms and items, is available from the authors.

The data set has 794 observations in total, with 364 observations for conventional-apparel enterprises and 430 observations for the organic-apparel firms. The useable observations amount to 750. We have 117 observations containing synthetic/cotton fiber blends, both in organic and conventional. The number of observations varies by item and by catalogue. Most catalogues have a large number of observations, except for four catalogues with less than 10 observations each. By contrast, several item categories have a limited number of observations.

In our empirical investigation we pondered the issue of a “reasonable” number of item categories. We initially used two criteria (step-wise regression and power analysis) to disqualify some item categories, but found that removing some item categories would obscure the identification of potential outliers. Therefore, we chose to keep the initial large set of items—in excess of 40 items. We investigated at length the potential presence of outliers on an individual observation basis, by catalogue groupings and by item groupings.

The data then consist of prices and categorical dummies for items, catalogues, gender, age, type of textile fiber used (organic cotton, conventional cotton), type of dyes, and an estimate of quantities sold by item. The categories are useful for capturing fixed effects specific to catalogues and items because we do not include all the attributes consumers may value, or the cost characteristics of suppliers (variable B in the hedonic function). One central concern is that the organic premium may reflect style or craftsmanship specific to a firm. The catalogue-fixed effects correct for that possibility.¹ From the National Cotton Council's *Cotton Counts its Customers* we constructed quantity estimates of each item produced. These quantity estimates are not specific to firms and they represent the best available palliative solution to the lack of actual sales data. The quantity estimates are used as weights in our econometric estimation. The weights are important because they reflect the relative contribution of item types to the average organic premium.

The National Cotton Council also provided the cotton-weight of items, which allows us to do two things. First, we can further quantify the organic/conventional cotton attribute by computing an approximation of the organic cotton content by item. This approximation provides a scalar quantitative measure of the organic attribute as in Rosen (1974), rather than a dichotomous/categorical definition of the environmental attribute (organic or conventional). Similarly, we treat the conventional cotton fiber content of regular apparel and the other fiber content for blend apparel items as two other continuous characteristics. Hence, with this quantitative definition, apparel items are defined on three dimensions representing their content of the three fiber types.

There are two ways to define the environmental attribute associated with organic cotton. The categorical approach avoids the potential pitfall of the quantitative definition of the organic attribute—a 100 percent organic shirt may not be twice as green as a 50/50 blend—but it does not allow us to test thoroughly the pricing behavior of organic-apparel firms. Indeed, the firm dummy variable is identical to the interaction terms (organic dummy*firm dummy) for organic-apparel firms, except for four firms selling both conventional and organic apparel goods. The quantitative definition (percentage of fiber) of the organic cotton content partially overcomes this problem because there is much variation in the fiber

content, and colinearity of the former type does not arise between organic fiber content and the firm categories.

We normalize the price by the amount of cotton included in the item to obtain an output price by unit of fiber content. This normalization allows us to reduce the prices to a common unit. Hence, the attribute valuation included into the output price is also normalized. The normalization allows us to think in terms of an organic cotton premium in reference to a price per unit of fiber weight. The mean price per pound of cotton is \$11.18, with a standard deviation of 5.29. Other normalizations are possible. One could normalize prices by square meters of fabric included in apparel goods rather than by fiber weight.²

A potential drawback of our data is that prices are not realized prices since we do not consider actual transactions. The prices we use represent rational expectations of prices by apparel firms. To address this problem, we checked the stability of prices over time by revisiting our data sources at a later date for possible sales at discounted prices. We did not find evidence of poor expectations corrected by discounted sales decisions. Another argument supporting the use of supply prices is found in Osborne and Smith (1997). In their investigation of the North Carolina beach rental markets they find that posted and realized prices were very close. Other studies have used this “catalogue-price” approach ignoring realized data. (e.g., Raff and Trajtenberg 1995). (Catherine Kling reminded the authors that in pre-Rosen days, this approach was actually popular and called the “Sears Catalogue Method.”)

Empirical Estimation and Results

The hedonic price equation is estimated for the apparel data using a semi-logarithmic functional form. Although there is no general consensus on a preferred “best” functional form, the semi-log form was chosen because it is widely used and is an accepted practice in the hedonic literature (Palmquist 1991; Graves, et al. 1988; and Cropper, Deck, and McConnell 1988).

The first goal of our empirical exercise is to identify the implicit price or premium associated with the organic cotton component of apparel. We present two sets of results with both the categorical and quantitative definitions of the organic attribute and using normalized prices. Using weighted least squares, the logarithm of the price of each piece of apparel, normalized by the pounds of cotton it contains, is regressed onto “core” attributes of the observations using the two following specifications:

$$\ln(\text{Price}/\text{fiber content}) = \beta + \alpha^T \text{items} + \gamma^T \text{catalogues} + \mu^T \text{gender} + \lambda^T (\text{age categories}) + \phi^T (\text{dye types}) + \eta \text{organic} \quad (\text{specification 1 in Table 1}), \text{ and}$$

$$\ln(\text{Price}/\text{fiber content}) = \beta + \alpha^T \text{items} + \gamma^T \text{catalogues} + \mu^T \text{gender} + \lambda^T (\text{age categories}) + \phi^T (\text{dye types}) + \eta_1 \text{percent organic} + \eta_2 \text{percent synthetic} \quad (\text{specification 2 in Table 1}),$$

where the various categories are expressed as dummy variables for items (socks, T-shirts, etc.), catalogues, gender (male, female, unisex), age (baby, youth, adult), dye type (low impact or no dyes), organic cotton categories (conventional cotton in the intercept), and shares of organic cotton and synthetic fibers in total fiber content.

We use weighted least squares (WLS) for two reasons: first, to obtain a better estimate of the aggregate premium by giving greater weight to items produced in larger quantities. Second, we believe that the variance in the price of items sold in small quantities may be greater than those sold in large quantities. Firms tend to use "small-quantity" items as "loss leaders" to attract customers. Doing the same with large-quantity items would be prohibitively expensive.³

The series of fixed effects by items, catalogues, and demographics captures the omitted attributes and cost structure, B_i , specific to each supplier and item type.⁴ This approach is well accepted in hedonic regressions (for example, see Feenstra and Levinsohn 1995). Table 1 shows that the estimated organic premium is robust to specification changes.

Table 1 reports results on the variables of interest for our investigation. The full results are available from the authors. As shown in column 1 of Table 1, the sign on organic is positive as expected and significant at the $\alpha = 0.0001$ level. The parameter estimate is 0.292317 and the Halvorsen-Palmquist-Kennedy formula (Halvorsen and Palmquist 1980; Kennedy 1981), implies an average premium of 33.8 percent. The second column reveals similar results using the quantitative definition of the organic attribute. The estimated premium is 33.2 percent using the latter definition. The premium reflects cost differences between conventional and organic apparel. First, organic cotton cost more because it is more expensive to produce than conventional cotton (a 45 percent premium in 1995). Based on the cotton content of items, this difference in the cost of the raw fiber alone would result, on average, in a organic apparel premium of 12.5 percent (a weighted average over all items using the 1995 cotton price premium). Additional substantial costs originate in ginning and spinning as the gins and mills must be shut down and cleaned before (usually small) organic cotton runs are spun. The weaving/knitting process is the same for conventional and organic textiles, but there are usually small-run penalties here as well. When the fabric is cut, a higher value of the scraps goes to waste. Again while the sewing process is the same, there are

Table 1

Variables of Interest	Specification 1 Core 1 only		Specification 2 Core 2 only		Specification 3 Core 1 and Health Variables		Specification 4 Core 2 and Health Variables	
	Estimated Premium	P-value	Estimated Premium	P-Value	Estimated Premium	P-Value	Estimated Premium	P-Value
LI	4.8%	0.3810	4.9%	0.4059	4.8%	0.3821	4.8%	0.3929
ND	−14.8%	0.0101	−14.8%	0.0145	−17.6%	0.0024	−17.6%	0.0038
Baby	10.7%	0.2899	14.2%	0.1994	−8.2%	0.5687	−4.6%	0.7938
Organic	33.8%	0.0001			31.7%	0.0001		
Porganic			33.2%	0.0001			31.2%	0.0001
Org* Baby					−18.7%	0.8797		
Porg* Baby							−14.9%	0.8448
ND* Baby					−10.7%	0.7923	−21.2%	0.8308
LI* Baby					−22.0%	0.9284	−26.5%	0.9871

Other coefficients not reported include ones for items, catalogs, age, and gender. LI refers to low impact dyes, ND refers to the use of no dyes, Porganic refers to the percent of organic fibers in each item, and Porg*Baby is the interaction between Porganic and the Baby dummy.

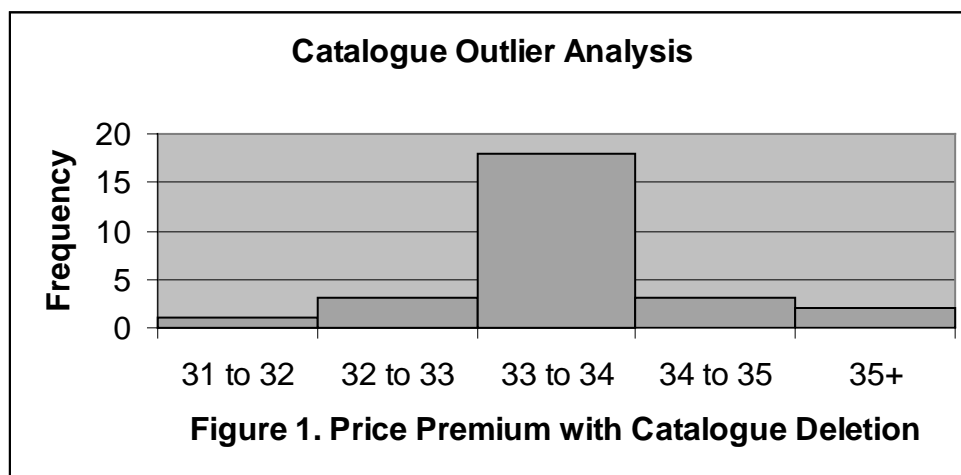
often small-run penalties here as well. A consensus estimate of the increased cost of production prior to marketing is between 20 percent to 40 percent⁵ Finally, the premium has to be interpreted cautiously because it reflects the additional willingness to pay for the organic attribute for consumers willing to buy such items. Many consumers do not buy organic apparel, and our estimated premium could not be readily used to infer welfare implications.

Many of the organic cotton clothes also employed environmentally friendly dyes or no dyes. The two most common claims made were that the dyes used in the manufacturing process were low impact (LI) or that they used no dyes at all (ND). Our specification allows one to test if these claims add to the purchase price. Table 1 indicates that a LI claim does not add any significant premium. On the other hand if the manufacturer used no dyes at all, then one could expect a 14.8 percent discount in the purchase price. These two results appear to be driven by cost implications and are consistent with consensus estimates of the cost of dying textiles. Obviously, it is less expensive not to dye an item than the opposite. A median consensus estimate of the additional cost of dying an apparel item is about 15 percent. Dying cost is fairly homogenous across dye types although some colors are more expensive. The lack of significance of the “environmentally friendly dye” dummy probably reflects this lack of cost difference for different dyes. (These consensus figures and information on cost of production come from Jeff Krauss and J. Rucker of the North Carolina State University School of Textiles.)

In the third and fourth column of Table 1 we report results for two specifications that allow for the interaction of ecological attributes with the baby category. Our hypothesis is that if there were a health component to the organic premium, it would show up most strongly in baby clothes, as children are commonly assumed to be more susceptible to toxins. If present, the organic baby interaction term in specifications three and four should capture this. Interestingly, there appears to be no significant additional premium for organic baby apparel in the WLS estimation. Inspection of the quantity weights used reveals that the weights for non-baby items are on average five times that of baby items. The observations in which such a baby premium may be present are heavily discounted. While quantity weighting is judicious to obtain economically meaningful estimates of the aggregate premiums of the attributes, it becomes much harder to detect an additional organicbaby premium if one existed.⁶

We now report on the robustness of the organic premium result. We analyze three potential sources of influence: catalogues, items, and single observations. The item and catalogue sources represent obvious candidates for group-outlier analysis, and these groups are less detectable running the usual outlier analysis deleting one observation at the time (Belsley, Kuh, and Welsch 1980).

The number of catalogues, especially of conventional apparel catalogues, included in the data set is not exhaustive. A legitimate question to address is whether the inclusion of any one particular catalogue is driving the results. If the results were sensitive to the inclusion/deletion of specific catalogues, then our results would lack generality and hence relevance. Group-outlier analysis focusing on the organic coefficient shows that dropping one catalogue's observations at a time can generate an estimated premium ranging from 31.8 percent to 37.4 percent, while the model predicts 33.8 percent with the full data set. This tight range suggests that no single firm is influential. The histogram shown in Figure 1 plots the estimated organic price premia after having deleted one catalogue's observations at the time. A lower premium corresponds to a deleted organic catalogue commanding a higher premium or to a deleted conventional catalogue associated with low prices.

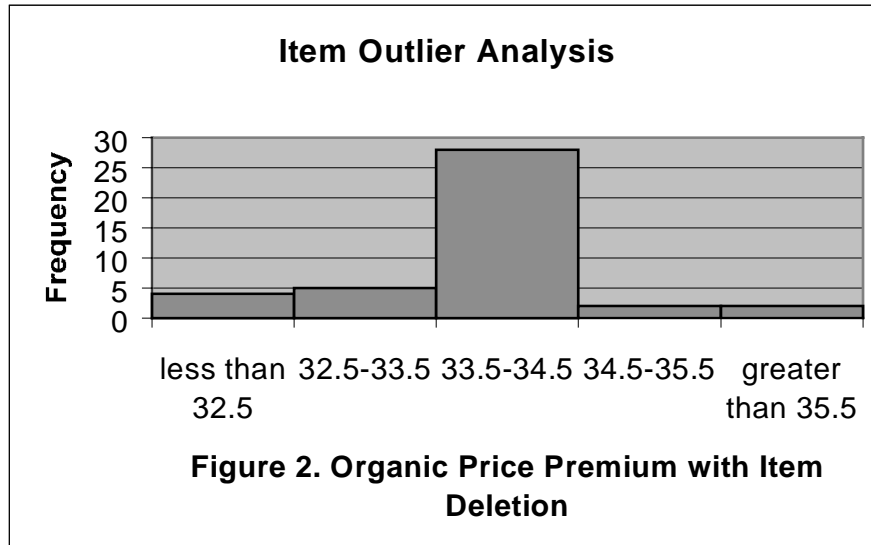


In Figure 1, the histogram appears normal, suggesting that the sample chosen is a representative one. Since Patagonia is the largest player in the organic cotton apparel market, a priori, if any firm exerted market power with respect to this characteristic, it would be Patagonia. The deletion of Patagonia causes a moderate fall in the estimated premium. There are several other catalogues whose deletion results in a larger drop.

To analyze this issue further we calculate the DFBETAS (Belsley, Kuh, and Welsch 1980) for the two catalogues whose deletion results in the largest decrease in the estimated premium. The Earth Care catalogue results in the largest decrease, but only one of the six observations has a DFBETA statistic larger than 0.073 (the critical value). Similarly, the Back to Basics catalogue, whose deletion results in the second largest reduction in the estimated premium, has only two of its 17 observations providing

significant DFBETA statistics. In summary, we cannot find a systematic outlying pattern associated with these two catalogues. If they commanded a brand-related premium, it should be reflected in a majority of the observations, which is not the case. Furthermore, there are six firms whose deletion results in lower estimated premiums than Patagonia. The stylized facts suggest that if Patagonia doesn't wield any market power with respect to this characteristic, then it is unlikely that any of the others do either.

Next, we explore the sensitivity to the deletion of apparel items. A similar pattern emerges as in the catalogue deletion exercise. Figure 2 is a histogram of the organic price premia obtained in 41 separate regressions, each deleting all the observations of one of the 41 items. The majority of the estimated values fall around the central value (about 33.8 percent) and the chart suggests a bell-shaped distribution. Although the changes in the estimated premium fluctuate within a fairly tight band, one item group, sweatshirts, exhibits the strongest influence. Its deletion induces a jump in the premium to 40 percent. At the opposite tail, deletion of turtlenecks induces the largest drop in premium to about 29 percent. Although the variation is not extreme, it indicates the importance of accounting for item-specific premium when analyzing pricing behavior. We incorporate this into our investigation of potential heterogeneous pricing by some suppliers.



Testing Pricing Behavior

As mentioned in the data section, we have two options to test the pricing behavior of organic apparel suppliers. These options are based on the two alternative measures of the organic attribute. We present results based on both definitions. The test using the categorical definition is limited because we can only

test the pricing behavior of four individual suppliers selling both conventional and organic apparel, with respect to the pricing behavior of all other organic apparel suppliers as a single pricing entity. As explained before, if a firm sells only organic apparel items, then the organic dummy everywhere equals one, and the interaction term (organic-catalogue) is perfectly collinear with the catalogue dummy. The test is interesting, however, because two of the six catalogues—the two whose deletion creates the largest drop in the estimated premium in the outlier analysis—are included in the test. They are the Tomorrow’s World and Natural Baby catalogues.

The second definition of the organic attribute allows us to test ten organic apparel suppliers, all using fiber blends, against the other organic catalogues offering only 100 percent organic items. In this second approach we can also test Patagonia’s pricing strategy. A set of linear restrictions imposes equality of the organic premium amongst all catalogues - each interaction term between the organic variable and the catalogue dummy is restricted to be equal to zero for all tested firms (4 in the first approach and 10 in the second approach). If all the organic-catalogue interaction terms are jointly equal to zero, then this is

Table 2: F Tests for Firm by Organic Interactions

Organic Dummy Specification		Percent Organic Specification	
Allows a joint F tests that 4 firm by organic interaction terms are jointly equal to zero.		Allows a joint F test that 10 firm by organic interaction terms are jointly equal to zero.	
F-value	0.6089	F-value	1.6088
P-value	0.6564	P-value	0.1002

evidence that the organic markup is constant across the tested firms. Given the potential interaction between items and the organic attribute noted in the outlier analysis, we include an item by organic interaction term. Table 2 reports the test results. Based on the first definition of the organic attribute, the joint F test for the restriction that the four interaction terms are jointly equal to zero indicated that the restriction cannot be rejected (p-value equal to 0.65), giving support for the equal-pricing hypothesis. The second approach provides a more comprehensive test of the “organic” pricing by ten separate firms. As shown in Table 2, the F test again indicates that this restriction cannot be rejected, offering further support for the similar pricing hypothesis. Given the evidence of ease of entry in the organic apparel market, we see our evidence as consistent with competitive pricing as opposed to a similar markup above marginal cost for all the organic firms.

Conclusions

Our results appear promising. We identify a robust organic premium, which, on average, is about 33.8 percent of the apparel price expressed in dollars per unit of fiber content. We also found a discount for the “no-dye” attribute, which mostly reflects the cost savings resulting from this simplified production. However, we could not find any evidence of a premium associated with environmentally friendly dyes, and we did not find conclusive evidence of additional premia for baby-organic items. Hence, the health motive, if any, does not seem to be revealed in the pricing of baby organic items.

Influential data points were found, but the results relative to the organic premium appear robust, with most estimates of the premium locating around a central value of 33.8 percent. Our findings on eco-labels are specific to the apparel industry and they await corroboration or refutation from ongoing investigation of ecolabels in other markets.

Finally, we find no evidence of heterogeneous pricing of the organic attribute by the organic-apparel firms included in our data set. With the provision of no barriers to entry, the premium for the organic attribute should tend towards a competitive level and should reflect the differences in cost of producing organic and conventional apparel. This reminds us of Perloff’s “quasi-theorem à la Chicago” based on the observation that when entry is not restricted, competitive pricing is often rapidly achieved when the number of firms in an industry increases beyond “a few.” The circumstantial evidence gathered from industry sources on the cost implications of using organic fibers and dyeing processes in textiles supports the conjecture that our estimated organic premium and no-dye discount reflect these cost differences.

REFERENCES

- Apodaca, Julia. "Market Potential of Organically Grown Cotton as a Niche Crop." Natural Fibers Research and Information Center, Bureau of Business Research, University of Texas at Austin. Paper presented at the Beltwide Cotton Conference in Nashville, TN, January 1992.
- Belsley, D.A., Kuh, E., and Welsch, R.E. *Regression Diagnostics*. New York: John Wiley & Sons, Inc., 1980.
- Bowen, Nicola. World Agrochemical Markets. PJB Publications Ltd., March 1991.
- Cropper, M.L., L.D. Deck, and K.E. McConnell. "On the Choice of Functional Forms for Hedonic Price Functions," *Review of Economics and Statistics* 70(1988): 668-75.
- Feenstra, R.C. "Exact Hedonic Price Indexes." *Review of Economics and Statistics* 77(1995):634-53.
- Feenstra, R.C. and J.A. Levinsohn. "Estimating Markups and Market Conduct with Multidimensional Product Attributes." *Review of Economic Studies* (62(1995):19-52.
- Freeman, A. M III. *The Measurement of Environmental and Resource Values. Theory and Methods*. Washington, D.C.: Resource for the Future, 1993.
- Graves, P., J.C. Murdoch, M.A. Thayer, and D. Waldman. "The Robustness of Hedonic Price Estimation: Urban Air Quality." *Land Economics* 64(1988):220-33.
- Halvorsen, R. and R. Palmquist. "The Interpretation of Dummy Variables in Semilogarithmic Equations." *American Economic Review* 70:474-75 (1980).
- Imhoff, Dan. "Growing Pains: Organic Cotton Tests the Fiber of Growers and Manufacturers Alike." reprinted on *Simple Life's* web page (simplelife.com), but first printed by *Farmer to Farmer*, December 1995.
- Imhoff, Dan, Lynda Grose, and Roberto Carra. "Organic Cotton Exhibit," Mimeo. *Simple Life* and distributed the Texas Organic Cotton Marketing Cooperative, O'Donnell, Texas (1996).
- Kennedy, P.E. "Estimation with Correctly Interpreted Dummy Variables in Semilogarithmic Equations," *American Economic Review* 71: 801 (1981).
- Kraus, Jeff. Lab Technician at the North Carolina School of Textiles. From a conversation on 10/4/98.
- Michaels, R.G. and V.K. Smith. "Market Segmentation And Valuing Amenities With Hedonic Models: The Case Of Hazardous Waste Sites." *Journal of Urban Economics*, 1990 28(2):223-42.
- Nelson, P. "Information and Consumer Behaviour." *Journal of Political Economy* 78(1970):311-29.
- Organization of Economic Cooperation and Development (OECD). "'Eco-labelling: Actual Effects of Selected Programmes," OCDE/GD (97) 105, 1997, Paris. (available on line at <http://www.oecd.org/env/eco/books.htm#trademono>)

- Osborne, L. "Market Structure, Hedonic Models, and the Valuation of Environmental Amenities." Unpublished Ph.D. dissertation. North Carolina State University, 1995.
- Osborne, L. and V.K. Smith. "Environmental Amenities, Product Differentiation, and market Power." Mimeo, 1997.
- Palmquist, R.B. "Hedonic Methods." In *Measuring the Demand for Environmental Improvement*. J.B. Braden and C.D. Kolstad, eds. Amsterdam, NL: Elsevier, 1991.
- Palmquist, R.B., F.M. Roka, and T.Vukina. "Hog Operations, Environmental Effects, and Residential Property Values." *Land Economics* 73(1):(1997):114-24.
- Perloff, J. "Industrial Organization Lecture Notes." Mimeo. University of California at Berkeley (1985).
- Raff, D. M.G. and M. Trajtenberg. "Quality-Adjusted Prices for the American Automobile Industry: 1906-1940." NBER Working Paper Series, Working Paper No. 5035, February 1995.
- Rosen, S., "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition." *Journal of Political Economy* 82:34-55 (1974).
- Teisl, M.F., B. Roe, and R.L. Hicks. "Can Eco-labels Tune a Market? Evidence from Dolphin-safe Labeling." Presented paper at the 1997 American Agricultural Economics Association Meetings, Toronto.
- U.S. Environmental Protection Agency. *National Water Quality Fact Inventory: 1990 Report to Congress*. EPA 503-9-92-006, Apr. 1992.
- Wasik, John, F. *Green Marketing and Management: A Global Perspective*. Blackwell Business: Cambridge, Mass, 1996.
- Zarrilli, S., V. Jha, and R. Vossenaar, eds. *Eco-labelling and International Trade*, St. Martin Press, Inc. New-York, 1997.

ENDNOTES

2. We also estimated our hedonic equation using the data from the four catalogues offering both conventional and organic items. We also include three catalogue-fixed effects. This approach is closer to the spirit of experimental design and should eliminate most style effects captured by the organic premium. We found a significant premium of 25.4 percent, which is a bit lower than with our full data set—partly because many items are not represented in this smaller data set of 177 observations.
 3. The normalization by square meters of fabric results in fewer usable observations due to lack of information on fabric content for some items. Estimation results based on the fabric normalization strongly suggest similar qualitative results as the ones obtained with the fiber content normalization.
 4. We thank an anonymous referee for this suggestion
 5. Demographics affect cost because the sophistication of given items and their cost tend to change with gender and age. For example, baby items use simpler cuts and stitching patterns than their adult counterparts.
 6. The figure of 20 percent was provided by K. Sweeney, Corporate Communication Office at Patagonia, and Trisha Feenly at Seventh Generation (re-named Harmony), indicated that the cost increase is between 20 percent to 40 percent, depending on items.
 7. Under OLS, a substantial and significant premium emerges for organic baby clothes. Less confidence is attached to the estimated premiums in these regressions because of lack of weights. They are suggestive that such an additional premium may exist. Conversely, the OLS runs do not show any significant interaction between the dyes and baby dummies. Investigation based on actual sales data will be necessary to settle the question of potential health motives captured by an additional “baby organic” premium.
-
1. We also estimated our hedonic equation using the data from the four catalogues offering both conventional and organic items. We also include three catalogue-fixed effects. This approach is closer to the spirit of experimental design and should eliminate most style effects captured by the organic premium. We found a significant premium of 25.4 percent, which is a bit lower than with our full data set—partly because many items are not represented in this smaller data set of 177 observations.
 2. The normalization by square meters of fabric results in fewer usable observations due to lack of information on fabric content for some items. Estimation results based on the fabric normalization

strongly suggest similar qualitative results as the ones obtained with the fiber content normalization.

3. We thank an anonymous referee for this suggestion
4. Demographics affect cost because the sophistication of given items and their cost tend to change with gender and age. For example, baby items use simpler cuts and stitching patterns than their adult counterparts.
5. The figure of 20 percent was provided by K. Sweeney, Corporate Communication Office at Patagonia, and Trisha Feenly at Seventh Generation (re-named Harmony), indicated that the cost increase is between 20 percent to 40 percent, depending on items.
6. Under OLS, a substantial and significant premium emerges for organic baby clothes. Less confidence is attached to the estimated premiums in these regressions because of lack of weights. They are suggestive that such an additional premium may exist. Conversely, the OLS runs do not show any significant interaction between the dyes and baby dummies. Investigation based on actual sales data will be necessary to settle the question of potential health motives captured by an additional “baby organic” premium.